Broadway Bridge
Spanning Willamette River on Broadway Street
Portland
Multnomah County
Oregon

HAER OR-22

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PHOTOGRAPHS
WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
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HISTORIC AMERICAN ENGINEERING RECORD

BROADWAY BRIDGE
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Location:	Spanning Willamette River on Broadway Street, Portland, Multnomah County, Oregon UTM: Portland, Oregon Quad. 10/525550/5041900
Date of Construction:	1912-13
Structural Type:	Steel through truss bascule bridge
Engineer:	Ralph Modjeski
Builder:	Pennsylvania Steel Company, Steelton, Pennsylvania; Union Bridge Company, Kansas City, Missouri
Owner:	City of Portland, Oregon, 1912-13 Multnomah County, Oregon, 1913-present
Use:	Vehicular and pedestrian bridge
Significance:	The Broadway Bridge was the first bascule span built in Portland, and at the time constructed, was the longest bascule span in the United States. It was the last bridge built across the Willamette River by the city of Portland, before the county took over construction and maintenance of bridges across the Willamette River. The bridge was designed by Ralph Modjeski, one of America's premier bridge designers. The Broadway Bridge is significant in design for its Rall-type bascule span, which has leaves that are engineered to roll backward as they swing upward, giving greater horizontal clearance for river traffic. It is one of only a few Rall bascule spans in the United States.
Project Information:	Documentation of the Broadway Bridge is part of the Oregon Historic Bridge Recording Project, conducted during the summer of 1990 under the co-sponsorship of HABS/HAER and the Oregon Department of Transportation. Researched and written by Gary Link, HAER Historian, 1990. Edited and transmitted by Lola Bennett, HAER Historian, 1992.
Related Documentation:	See also HAER OR-55, Willamette River Bridges.

HISTORY

Because navigable waterways are under the jurisdiction of the federal government, an enabling act by Congress, passed February 2, 1870, was required to allow for the building of bridges across the Willamette River at Portland. In the following decade several bridge-building stock companies incorporated and made plans to span the river, but no bridges were built. Lack of money was sometimes the reason for these failures, but for the most part it was due to opposition by ferry operators fearing the loss of their businesses, and navigation interests (railroads and shipping) which feared bridges would impede river traffic. The two were supported by the opinion of the U.S. Army Corps of Engineers, Portland District, which agreed that bridges would obstruct navigation.[1]

In 1880 the Pacific Bridge Company began constructing a bridge across the Willamette River at the foot of Morrison Street for the Willamette Iron Bridge Company. Federal Judge Matthew Deady handed down an injunction halting construction in March 1881. Judge Deady wrote that, according to the act that admitted Oregon to the Union on February 14, 1856, the river was a common highway and should remain unobstructed. In 1885 the U.S. Supreme Court wrote that the admission act did not prohibit bridges. Construction of a bridge at Morrison Street was restarted and the bridge was completed April 7, 1887. One year later the Supreme Court overturned Judge Deady's ruling of 1881.[2]

With legal obstacles to bridging the Willamette River cleared, bridge building proceeded in earnest at Portland. The first Morrison Bridge was followed by an all-steel bridge in 1889, the Madison Street Bridge in 1891, and the Burnside Bridge in 1894. These first bridges were light and not of durable construction. The Madison Street Bridge was replaced in 1900, the Morrison Bridge was replaced in 1905, the second Madison Street Bridge was replaced in 1910, and the steel bridge in 1912.[3]

By the time the first wave of light bridges had been replaced, the demography of Portland was such that the west side contained the central business section and the east side was a rapidly growing residential section. The east side residents demanded additional bridges to provide quicker crossing to the west side. Voters approved ballot measures in 1909 which authorized construction of a bridge at the foot of Broadway Street, a bond issue of $450,000 for the bridge, and a 1 percent tax for a general bridge fund. In addition to giving more access to the west side from the growing residential east side, residents and planners expected the bridge to accelerate economic development of northern Portland down the Willamette River.[4]

The bridge would connect Broadway Street and Seventh Street. The City of Portland acquired land for the approach on the east side in a 1910 swap with the Oregon Railway and Navigation Company. The city vacated the ends of fourteen streets upon which the OR & N built ramps for the new Steel Bridge, while the railroad company moved a section of track to clear land for the Broadway Bridge's ramps. The city then took bids for a bascule span. Portland had moveable bridges of the swing and vertical lift types, but bascules were considered to provide quicker and safer openings. The city received bids on four kinds of bascule spans: Strauss bascule, Scherzer rolling-lift, modified Strauss, and Rall bascule. Each of the contractors' submissions showed the Rall bascule to be the least expensive. The Pennsylvania Steel Company of Steelton, Pennsylvania, received the construction contract.[5]

Ralph Modjeski, who had previously worked in Oregon constructing railroad bridges, was hired to design and supervise construction. Modjeski was a Polish-born, French-educated engineer who had made a reputation building massive steel bridges over the Mississippi River. His bridges were called "characteristically American" because they were a symbol of the United States' great steel industry. In the 1920s he gained international recognition and honors for suspension bridges he designed in Pennsylvania. At the time of his death in 1940, the <u>New York</u>

<u>Times</u> called Modjeski the leading bridge builder in the world.[6]

Construction commenced on April 1, 1912, and was completed one year later. The city and residents held a great celebration for its opening on April 22. Several ships passed through the drawspan, which had been constructed with the leaves open. Then the leaves were lowered. When they closed, celebrants crowding the deck rushed across the bridge in a footrace to the center amidst crowds of several thousand cheering onlookers.[7]

DESCRIPTION

The Broadway Bridge consists of five secondary steel through truss spans and one double-leaf steel through truss bascule span of the Rall type. The three west side secondary trusses are of the Pennsylvania Petit design, while the east side has one Pennsylvania Petit truss and one Pratt truss. The road deck of the secondary spans are concrete while the bascule deck is steel grate. All steel of the superstructure is painted red as part of Multnomah County's color coding of its bridges. No one is sure if red was chosen to match the red roof tiles of nearby Union Station or to match the bridge the shade is named for, "Golden Gate Red."[8]

Total length of the bridge is 1736'. The width from the outside of the trusses is 70'. The roadway is 46'-6" wide (four lanes) and the timber-planked sidewalks, each lined by wrought-iron railing, are 11'-3" wide. The central span is 270' long and lateral clearance through the two centermost piers is 250'.[9]

The City of Portland chose a bascule span for this bridge. Bascules were considered safer than swing spans and vertical lift spans because the opening leaves provide a barrier to prevent vehicles from driving into the water. The Rall-type bascule was chosen for reasons of economy. Its advantage in design is that as the leaves swing upward, they also roll backward away from the channel to provide more horizontal clearance for river traffic.[10]

On the Broadway Bridge, the two leaves of the bascule are identical (except that the west side contains the locking mechanism). Each leaf consists of two trusses supported on a Rall wheel above the deck. The ends of the shaft of the Rall wheels support the leaf and counterweight. The Rall wheels travel 25 feet on tracks 32'-8" long and 40" wide. Both Rall wheels and tracks are made of nickel-chrome-steel. The shafts are hollow forged steel. At the top of the truss, operating struts, located 12 feet on either side of the center line, rotate the leaf about the Rall wheels. The bottom of each operating strut has teeth which mesh with the main drive pinions. These pinions are driven by gear reduction machinery, powered by two 75-horsepower motors. The operating struts are lined with bracing and weigh 21 tons. They are 91' long and travel 63 feet during operation. The control struts, one end attached to the inside of the track girder and the other to the counterweight box, regulate the travel of the Rall wheels. Anchor struts, connecting the top chords of the bascule leaf and truss of the adjacent span, carry the strain of the live load when the leaves are closed. These struts are 52' long and travel 35 feet during operation. Each leaf has a concrete counterweight. While they are outwardly identical--44' wide, 26½' high, and 15' thick--the west counterweight weighs over twenty tons more than the east. This is to compensate for the locking mechanism located at the end of the west leaf. Each counterweight contains chambers which can be filled to adjust the balance of the leaf. When the leaves are fully open, the counterweights descend to within eight inches of the roadway deck.[11]

Above the roadway operator houses are located at the centermost end of the anchor spans. One is on the upstream side of the east end and the other on the downstream side of the west end. From the west side the operator can control both leaves of the bascule span. The east side house contains electrical contacts.[12]

Piers 5 and 6, which carry the bascule span, sit on caissons measuring 33'x90'x50'. The piers are concrete with granite facing, in courses of alternating headers and stretchers. Above this section are three granite belt courses, and the pier is topped by a granite coping. The granite was cut near Puget Sound. Piers 4 and 7 also rest on caissons. From these caissons rise two steel cylinders, 12' in diameter, filled with reinforced concrete. The cylinders are 50' apart center to center, and connected by vertical and diagonal steel bracing. Atop each cylinder sit concrete copings which hold the bridge seats.[13]

The east side approaches connect the bridge to Broadway Street, U.S. Highway 99E, and Interstate 5. On the west side approaches connect the bridge with Broadway Street and Lovejoy Street. The approaches total twenty reinforced concrete deck girder spans. All approach spans are decked with concrete.

CONSTRUCTION

The Broadway Bridge was designed and built under the supervision of Ralph Modjeski. W.R. Weidman was the resident engineer in charge of the substructure, H.M. Harps was in charge of the superstructure. The Pennsylvania Steel Company of Steelton, Pennsylvania fabricated and erected the superstructure. The Union Bridge and Construction Company of Kansas City, Missouri built the substructure. The Strobel Steel Construction Company of Chicago, Illinois received $12,000 in royalties for the use of the Rall design.[14]

A total of 5519 cubic yards of excavation was moved in building the bridge. Workers drove 18,836 feet of timber piling and 14,050 feet of reinforced concrete piling. Cut granite for the pier facing totaled 8,747 cubic yards, and 256 cubic yards of granite were used in the coping and belt courses. Over 110 tons of reinforcing steel was used, structural steel totaled 7,912 tons.[15]

As originally built, the Broadway Bridge consisted of a bascule span, four Pennsylvania Petit through truss spans, and two Pratt truss spans. The bascule deck was Shuman flooring and the decks of the secondary spans were creosoted wood. Two streetcar rail lines crossed the bridge--one of a normal gauge and one of narrower gauge for the cars of the Portland Railway Light and Power Company. Approaches connected the bridge with Broadway Street on both sides (the west side was named Seventh Street before the bridge opened).[16]

Construction began on April 1, 1912. The river piers are set on gravel, as a solid rock foundation was at a depth too far to be reached. Timber piles were used for these piers. The caisson were constructed using the pneumatic process, in which 44 lbs. of air pressure were used inside the caisson to help keep water and mud out. The high pressure caused work shifts to be limited to two hours at a time, to prevent workers from getting the bends. Piers 2 and 3 are also on timber piles. Pier 1, the counterforts of the approach retaining walls, and pedestals for the plate girder spans were on reinforced concrete piles.[17]

The superstructure was erected by a traveler with three booms which ran on rails on temporary ties on the steel stringers. Material for the west side was delivered to the traveler via a railroad already in the area. The same traveler was used to construct the east side. Materials on this end were delivered to the traveler from a barge on the river. The bascule was erected in the open position 80 degrees from horizontal. The bridge opened April 22, 1913. Total cost of construction was $1,586,922.[18]

MAINTENANCE AND RENOVATION

In 1913 the Oregon state legislature made bridge building and maintenance in Portland the responsibility of Multnomah County. Immediately upon opening, the City of Portland presented the bridge to the county. The streetcar lines which crossed the bridge remained the responsibility of the city.[19]

Since 1913 the Broadway Bridge has undergone major changes. In 1927 the bridge closed for six months for renovation. The end Pratt truss span was replaced with a box girder span, the approaches were widened and the entire bridge was redecked with concrete, except for the drawspan which was redone with Port Orford Cedar. The following year approaches were completed connecting the bridge with Lovejoy Street and Tenth Street. In 1949 the drawspan was again redecked, this time with steel grate at a cost of $78,000. The eastern approaches were redone in 1950-51; a viaduct was built to carry traffic above proposed Interstate 5, while a cloverleaf took traffic onto the interstate northbound. In 1982 the bascule leaves required repair for the first time, as control struts attached to the counterweights were replaced at a cost of $250,000. That same year, as a part of the Portland Bicycle Route System, signals and curb ramps were added at a cost of $18,000.[20]

ENDNOTES

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2. "A Sketch of the History and Construction of the Willamette River Bridges," Oregon Historical Society Collection, 14 January 1960; Lockley, pp.535-36.

3. Sharon Wood, The Portland Bridge Book (Portland: Oregon Historical Society Press, 1989), p.92.

4. E. Kimbark MacColl, Merchants, Money and Power: The Portland Establishment 1843-1913 (Portland: The Georgian Press, 1988), p.419; Jack Ostergren, "Busy Broadway Bridge Built to Last 100 Years," Oregon Journal, 11 June 1968, p.4.

5. Hardesty, "The Broadway Bridge," p.706; MacColl, Merchants, pp.429-30.

6. Thomas Duszak, "A Music Student Bridges the World," Pennsylvania Heritage, Winter, 1986.

7. Hardesty, p.709; Sharon Wood, "Robust Broadway Bridge Celebrates 71st Year in Fine Shape," The Oregonian, 23 April 1984, p.B5.

8. ODOT, Environmental Section, Bridge File #6757, "Engineering Antiquities Survey," April 1983; Ostergren, p.4; Dwight Smith, James Norman, and Pieter Dykman, Historic Highway Bridges of Oregon (Portland: Oregon Historical Society Press, 1989), p.116.

9. ODOT, Environmental Section, Bridge File #6757, "Engineering Antiquities Survey," April 1983.

10. George A. Hool and W.S. Kinne, eds., Moveable and Long-Span Steel Bridges (New York: McGraw-Hill Book Company, Inc., 1943), pp.4-5, 19.

11. Bart Bonney, interviews July 11 and August 2, 1990; Hardesty, pp.706-708.

12. Bart Bonney; Hardesty, p.709.

13. Bart Bonney; Hardesty, p.705.

14. Hardesty, p.710.

15. Ibid., pp.705-06.

16. Ibid., p.706; Wood, "Busy Broadway."

17. Hardesty, pp.704-05.

18. "Engineering Antiquities Survey"; Hardesty, pp.708-10.

19. "Engineering Antiquities Survey"; ODOT Bridge Section, Bridge File #6757, "Memoranda of the Obligation of the City of Portland Relative to Certain Wilamette River Bridges," [1937].

20. Bart Bonney; Ostergren, "Busy Broadway"; Wood, "Robust Broadway."

ADDENDUM TO
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